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Air Drum Using Kinect and Arduino

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***Abstract*—With the invention of the low-cost Microsoft Kinect sensor, high-resolution depth and visual (RGB) sensing has become available for widespread use. The complementary nature of the depth and visual information provided by the Kinect sensor opens up new opportunities to solve fundamental problems in computer vision. Human Computer Interaction is becoming a major component in computer science related fields allowing humans to communicate with machines in very simple ways exploring new dimensions of research. This paper presents a comprehensive review of recent Kinect-based computer vision and experimental efforts on virtual music instrument Drum , based on Kinect sensor is presented. The instrument has virtually set the relevant sensing input areas, as an example, cymbals of the drum, then, the player controls the instrument through those virtual inputs through the Kinect. Sound control data is then generated and fed to the audio library based on the musically oriented human computer interaction gestures, composing a real time musical expressive performance. A live performance using the presented virtual instrument was carried out at the end.**

Index Terms*—Computer vision, depth image, information fusion, Kinect sensor *MIDI, VST instrument, OpenNI, Midi port, RtMIDI.

I. INTRODUCTION

As Human Computer Interaction (HCI) evolves in many different areas of human interactions with the computers or machines, this generation and composing of music based performance with advanced sensing devices is becoming hot research topic and a promising application area for the high revenue entertainment markets based on Internet, PCs, and laptops and especially with the smart mobile devices. Here the most important hurdle is correctly sensing of the human gestures through the new age sensors. In this paper authors present their experience of musical performance with the use of the virtual instrument, Drum. The instrument capture the human gestures through the Microsoft Kinect sensor. Kinect is a sensor which is capable of capturing depth and color information of the user in front of it using an array of RGB and infrared cameras. Further it is capable of capturing the sound input though an array of microphones. OpenNI library is used to interface with the Kinect sensor in the proposed design. In detail design and connectivity information is given in section 3. The audio is played using simple WAV format files. These files are triggered as soon as the wrist enters the specified coordinate. We also using arduino to play the sound for the Base Drum and Hi Hat . we will be designing pedals for the same. The rest of the paper organizes as follows. Design and operation of the musical instruments and related concepts to the kinect are discussed in the section III. Section IV discusses pedal design and functioning of arduino. While section V discusses future directions.

II. DESIGN

In this section, presented musical instruments and its operations are discussed. Microsoft Kinect sensor[1] is used as the main interaction tool between the human player and the computer. In the instrument, Kinect captures the RGB color and depth information in the rate of 30 fps, each with the spatial resolution of 640x480 pixels. The standard 3D sensing framework OpenNI was used as the driver and API to communicate with the Kinect. Once the depth information is captured using Kinect, user skeleton can be obtained with the available functions of OpenNI with 20 joints. Then using the shoulder coordinates as reference we map each joint, a suitable strategy can be implemented to play the instrument virtually. Fig. 1 displays the steps of the general architecture used in each instrument.

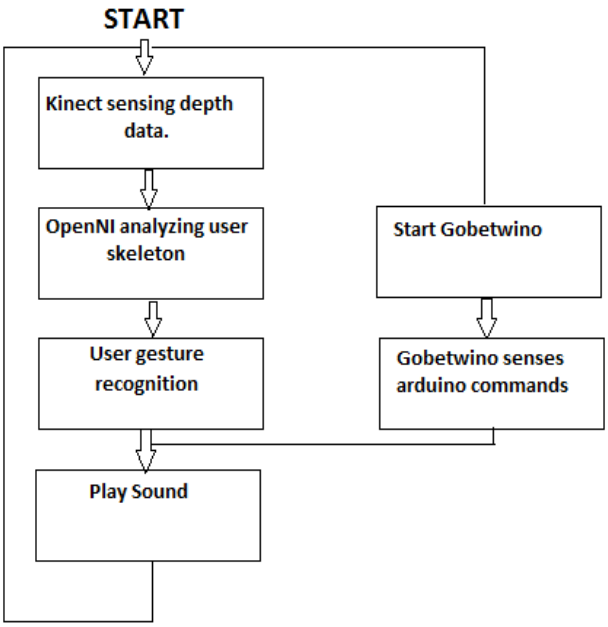


Fig. 1. Virtual instruments architecture

With the inherence qualities like ease of use, ease of communication, very low data rates etc. We have used WAV *Waveform Audio* file format to play the sound.

III. OPERATION FOR KINECT

First, as explained above using Kinect and OpenNI, user skeleton is acquired. Then four areas in front of the user is identified a the Snare, Tom, Crash Cymbal and Ride

Cymbal. Wrists are used as the triggers against the above specified regions. When the coordinate of the triggering point is within the edges of the specified region of the virtual drum sets, program triggers WAV sound files. Respective regions and a sample of user depth data map is shown in Fig. 3(a). Standing view of the player is shown in Fig. 3(b) with the depth map on the screen.

Algorithm :

1. Capture the coordinates of the Head, Left Hand, Right Hand, Left Knee, Right Knee, Torso center, Right and Left Hip positions using Kinect sensor through OpenNI depth and skeleton data (Fig. 2).
   Use Shoulder joint as a reference.
2. Draw the Tom, Cymbals, Snare on the screen w.r.t the shoulder joint.
   Trigger is set off when wrist enters the specified box.
3. Play sound according to the trigger.
4. Go back to 1 (next frame)

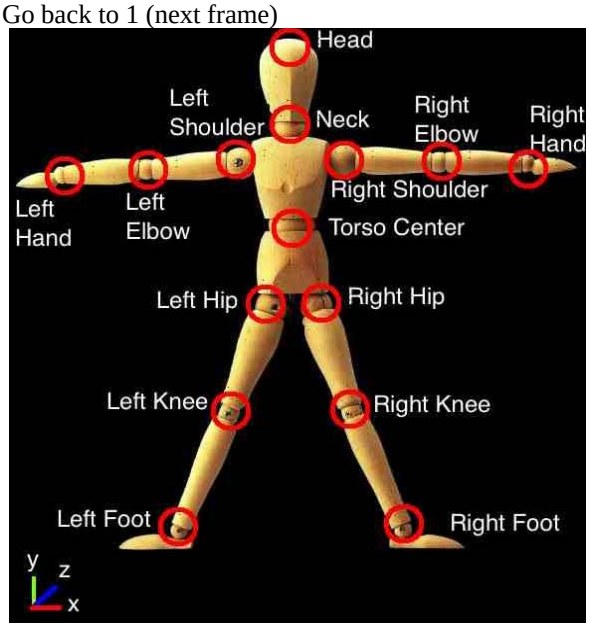
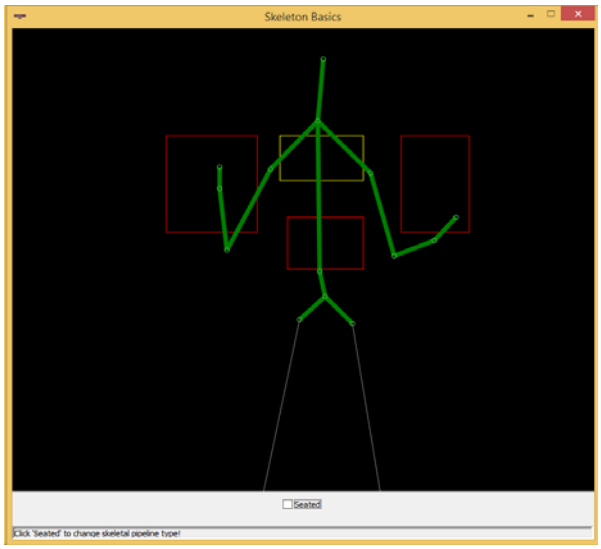
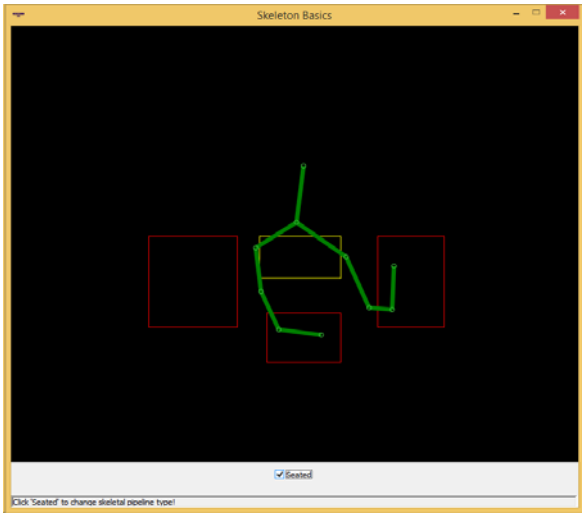


Fig 2. Major Co-ordinate Positions of the Human Skeleton



(a)



(b)

Fig 3. Design of drums and skeleton mapping (a) Standing position (b) Seated position.

IV. Operation Of Arduino

We have created two foot pedals Figure(5),its circuit is shown in Fig, 4. A cantilever switch Figure(6) is used to register the pedal press. Once the press is registered we use a script to trigger the sound. The script we are using is called Gobetwino, it is an open source script that responds to serial responses received from the arduino. A set of commands are created in the script which have to be executed according to the response from the arduino. The commands then trigger the sound file from the computer.

Algorithm:

1. Write code to register inputs to the arduino from cantilever switch.
2. This continuously sends 1023 as an output serial.
3. When we press the switch value changes to 0.
4. This value 0 is used as a trigger.
5. Create SPEX command in Gobetwino to play sound file from computer when 0 is received as a trigger.
6. Burn the arduino code to the board.
7. Connect arduino to PC via USB and start Gobetwino.
8. When pedal is pressed Gobetwino registers it and executes the corresponding command.
9. Sound is played.
10. Return to 8.

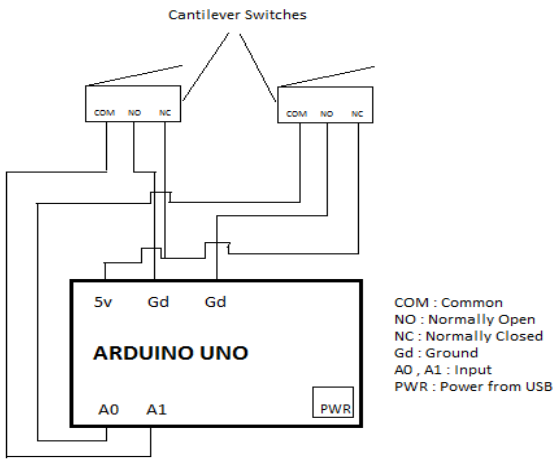
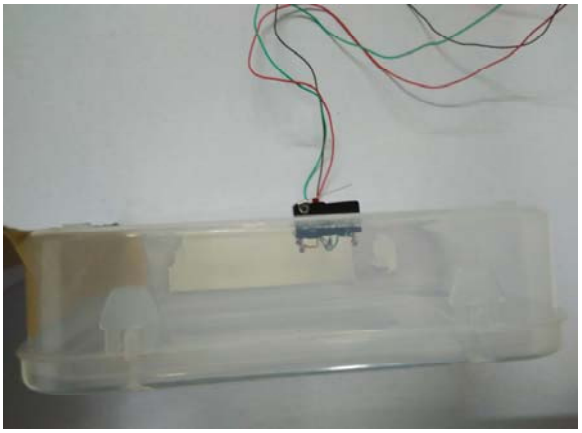
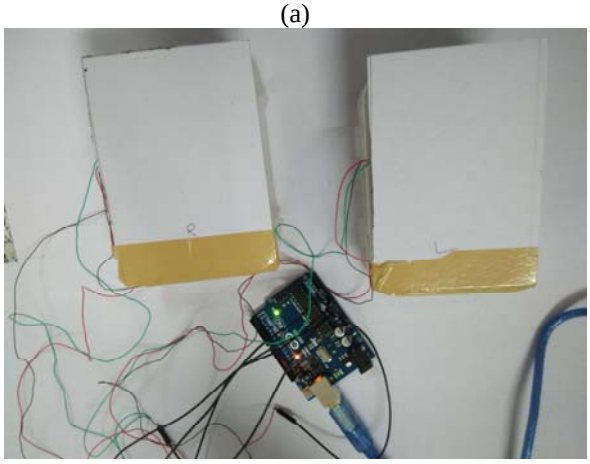


Fig 4: Circuit of Arduino



(a)



(b)

Fig. 5 : Foot Pedals (a) Side view (b) Top view

Fig 6:Cantilever switch

V. Future Scope

Kinect SDK is a whole open source software. It has many aspects to work with like voice recognition, infrared tracking and so on. The new version of kinect has also come into use i.e Kinect 2.0, this version helps us to control interaction in more detail.

Arduino in itself is like a mini computer. It has its many shields that can extend its ability to control servo motors and various other technologies like Bluetooth and Wi-Fi.

This project is just a version for a user to get an idea of playing basic parts of the drums without having to make an investment. In the future it is possible to improve on this project so as to provide an all-round experience with reduced delays. In the field of music one can design an interface to control DJing softwares and other instruments. In field of medicine Kinect and Arduino together can be used to build automatic voice controlled wheelchairs. And keep a track of patients health with use of Kinect 2.0 as it has heart rate sensors and more. In the field of sports the kinect can be used to learn movements of players and provide an experience of playing against them. In field of education it can be an interactive and fun way to learn new things by immersing in the learning process. So the possibilities are endless and just requires an idea and perseverance.

VI. Conclusions

In this project air drum kit has been implemented using kinect and arduino. We have come across the following draw backs:

1. Delay
2. Efficiency

These drawbacks can be overcomed using more robust hardware.

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